Facilitating Access to EOS Data at the NSIDC DAAC

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The Promise and Perils of Standard Data Formats

- NASA's motivation
- Has it facilitated access to EOS data?
  - For many it has been an impediment
  - Reasons
    - tool development lagged product availability
    - poor user education on the part of the DAACs
    - instrument teams straying from the standard
    - immature status of the standard

Response of the NSIDC DAAC

- Unique needs of the polar research community
- Tools
  - Access, subset, visualize
  - Gridding of swath (Level 1 and Level 2) data
- Help page and FAQ
  - Instructions on extracting binary arrays using NCSA utilities or using an IDL program

Hierarchical Data Format - Earth Observing System (HDF-EOS)

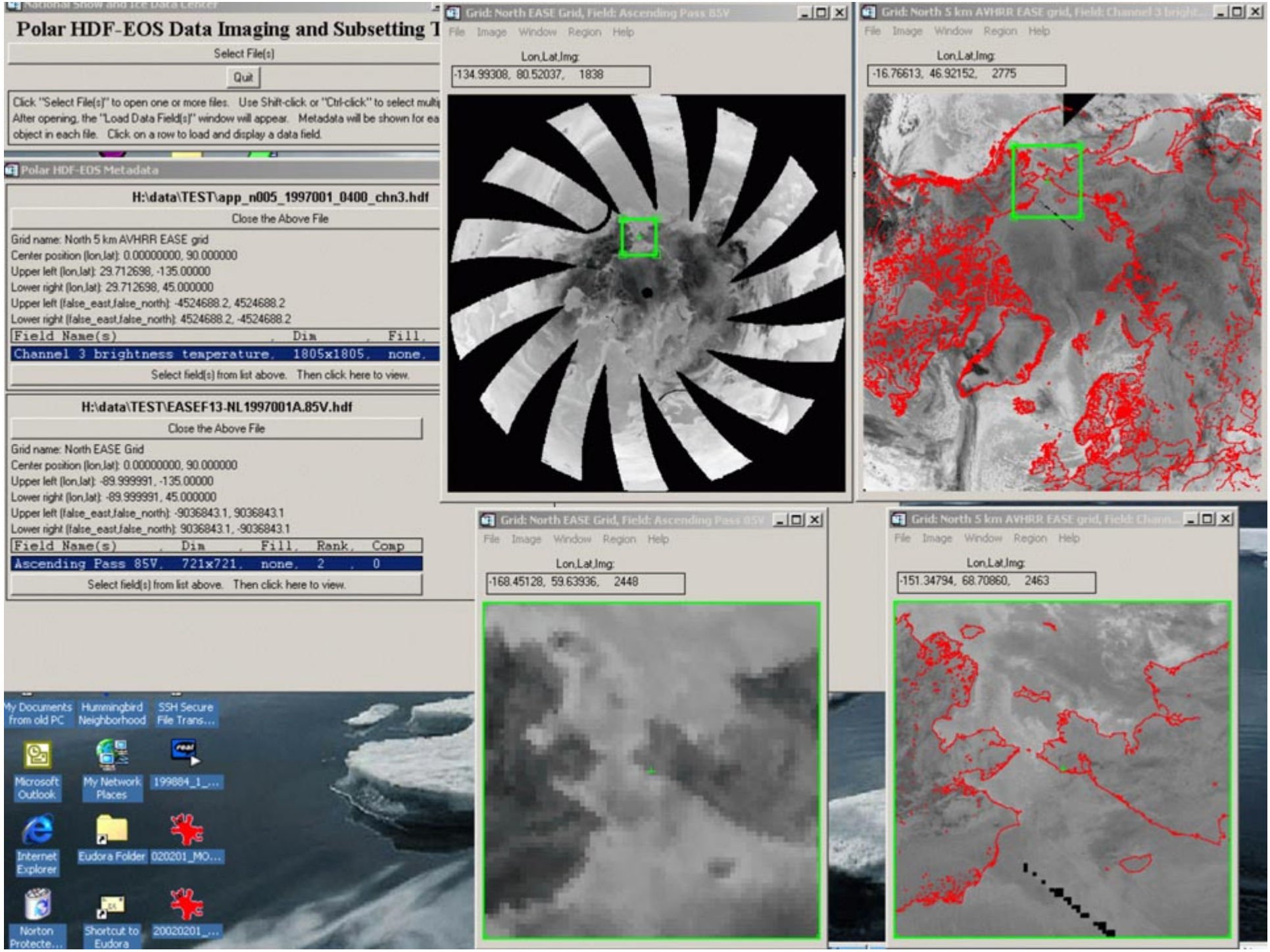
Home | Introduction | HDF to Binary | hdfeos2bin | HDF to ASCII | Geolocating HDF-EOS data | Related Links

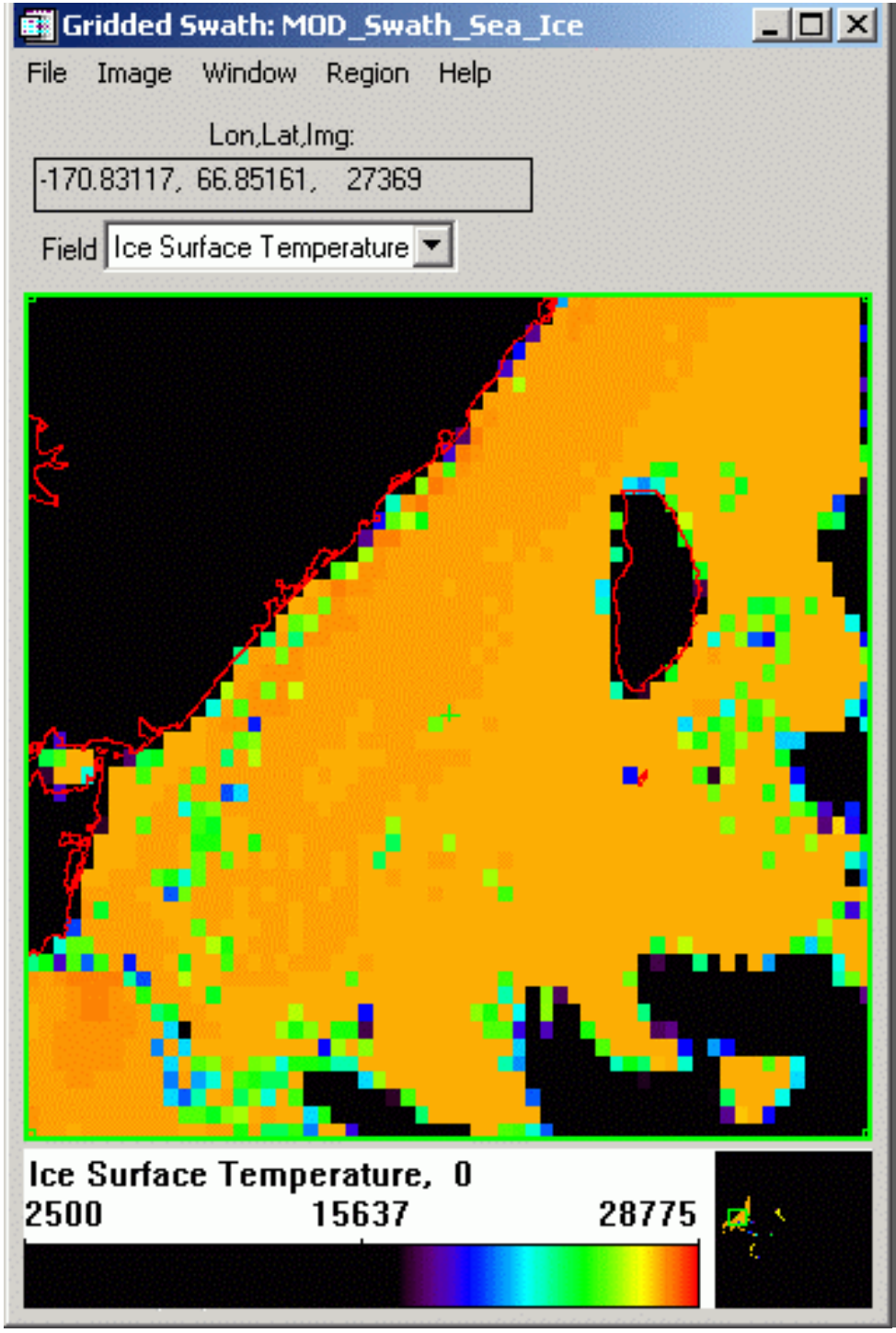
Hierarchical Data Format (HDF) is the standard data format for all NASA Earth Observing System (EOS) data products. HDF is a multi-object file format developed at the National Center for Supercomputing Applications (NCSA) at the University of Illinois.

Because HDF-EOS is a relatively new format for the earth science user community, NSIDC created this site to answer common questions about HDF-EOS and to provide simple methods for working with the HDF-EOS format. Follow the links below to read more about working with HDF-EOS:

PHDIS Tool

- The Polar HDF-EOS Data Imaging and Subsetting Tool
  - IDL-based (multi-platform)
- For any HDF-EOS file a user can:
  - Examine file contents
  - View Core and Structural metadata
  - Visualize and compare the data fields
  - Couple images from different grids.
  - Overlay lat/lon lines and/or coastlines
  - Designate subregions for zoom or display/export
  - Move between table cell and image pixel


Polar HDF-EOS Data Imaging and Subsetting T
Select File(s)
Quit
Click "Select File(s)" to open one or more files. Use Shift-click or "Ctrl-click" to select multi
After opening, the "Load Data Field(s)" window will appear. Metadata will be shown for ea
object in each file. Click on a row to load and display a data field.
Polar HDF-EOS Metadata
H:\data\TEST\app_n005_1997001_0400_chn3.hdf
Close the Above File
Grid name: North 5 km AVHRR EASE grid
Center position (lon,lat): 0.00000000, 90.000000
Upper left (lon,lat): 29.712698, -135.00000
Lower right (lon,lat): 29.712698, 45.000000
Upper left (false_east,false_north): -4524688.2, 4524688.2
Lower right (false_east,false_north): 4524688.2, -4524688.2
Field Name(s) , Dim , Fill,
Channel 3 brightness temperature, 1805x1805, none,
Select field(s) from list above. Then click here to view.
H:\data\TEST\EASEF13-NL1997001A.85V.hdf
Close the Above File
Grid name: North EASE Grid
Center position (lon,lat): 0.00000000, 90.000000
Upper left (lon,lat): -89.999991, -135.00000
Lower right (lon,lat): -89.999991, 45.000000
Upper left (false_east,false_north): -9036843.1, 9036843.1
Lower right (false_east,false_north): 9036843.1, -9036843.1
Field Name(s) , Dim , Fill, Rank, Comp
Ascending Pass 85V, 721x721, none, 2 , 0
Select field(s) from list above. Then click here to view.
Grid: North EASE Grid, Field: Ascending Pass 85V
File Image Window Region Help
Lon,Lat,Img:
-134.99308, 80.52037, 1838
Grid: North 5 km AVHRR EASE grid, Field: Channel 3 bright...
File Image Window Region Help
Lon,Lat,Img:
-16.76613, 46.92152, 2775
Grid: North EASE Grid, Field: Ascending Pass 85V
File Image Window Region Help
Lon,Lat,Img:
-168.45128, 59.63936, 2448
Grid: North 5 km AVHRR EASE grid, Field: Chann...
File Image Window Region Help
Lon,Lat,Img:
-151.34794, 68.70860, 2463
My Documents from old PC
Hummingbird Neighborhood
SSH Secure File Trans...
Microsoft Outlook
My Network Places
199884_1_...
Internet Explorer
Eudora Folder
020201_MO...
Norton Protecte...
Shortcut to Eudora
20020201_...

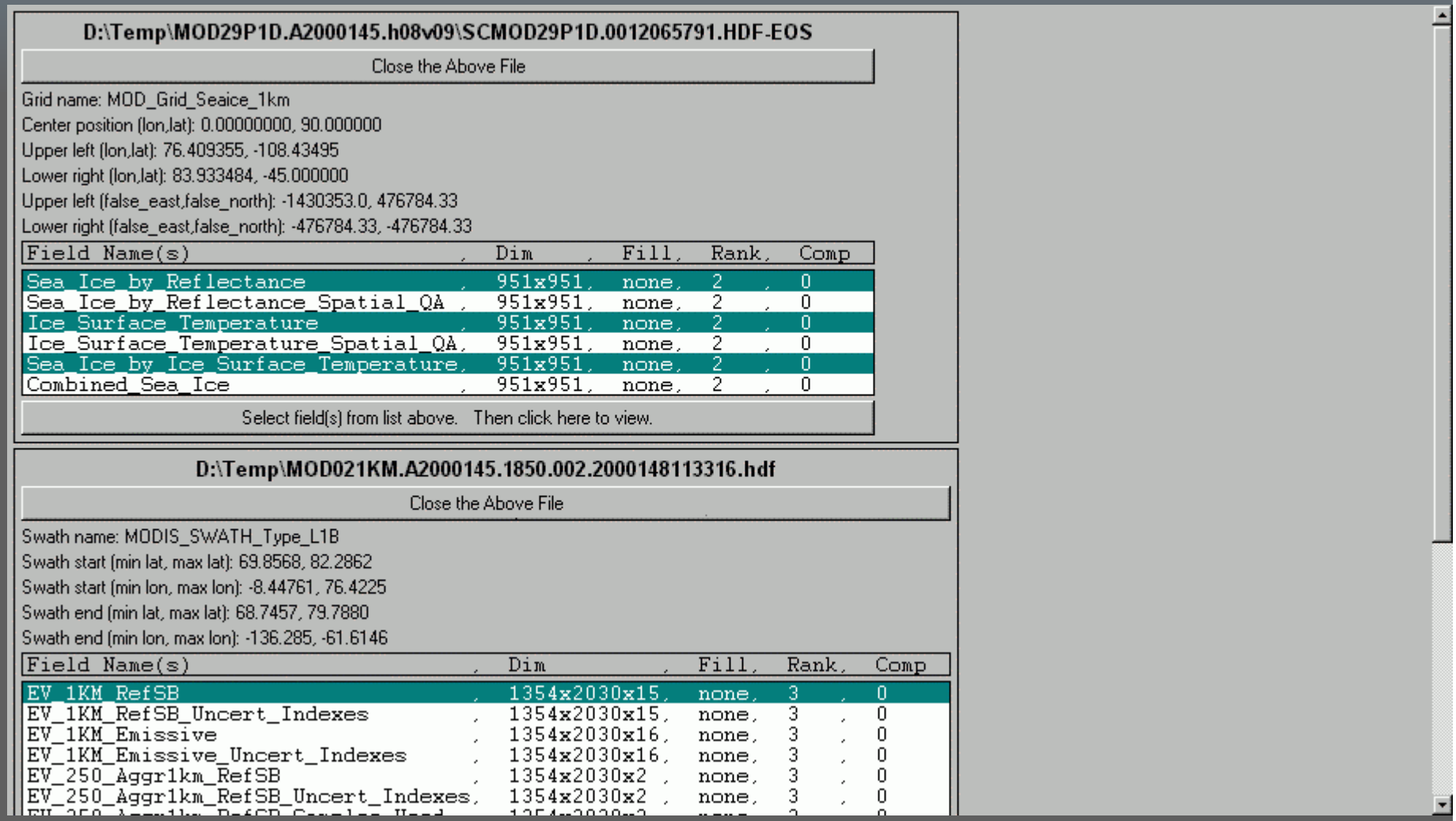


PHDIS zoom window MODIS Sea Ice.

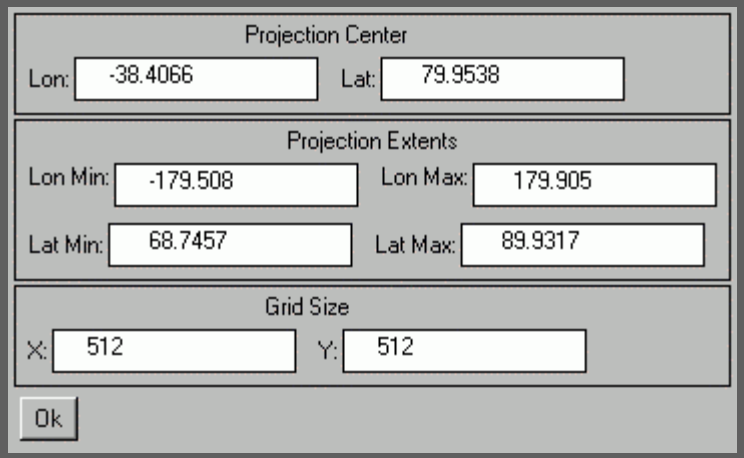
Legend includes:

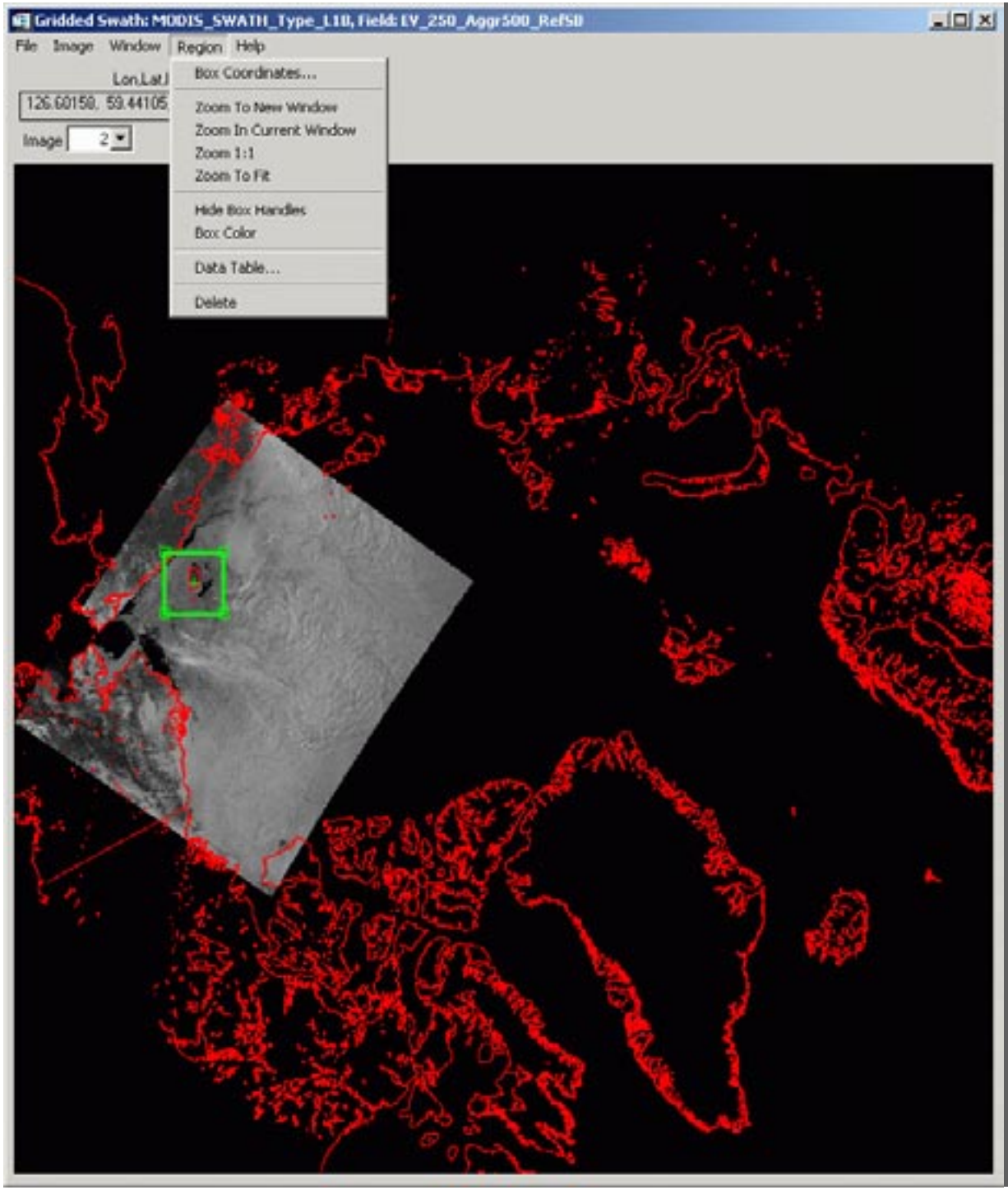
- **color scale**
- **thumbnail locator**
- **lat/lon, value under cursor**

Metadata display and field selection



Gridding options for swath data





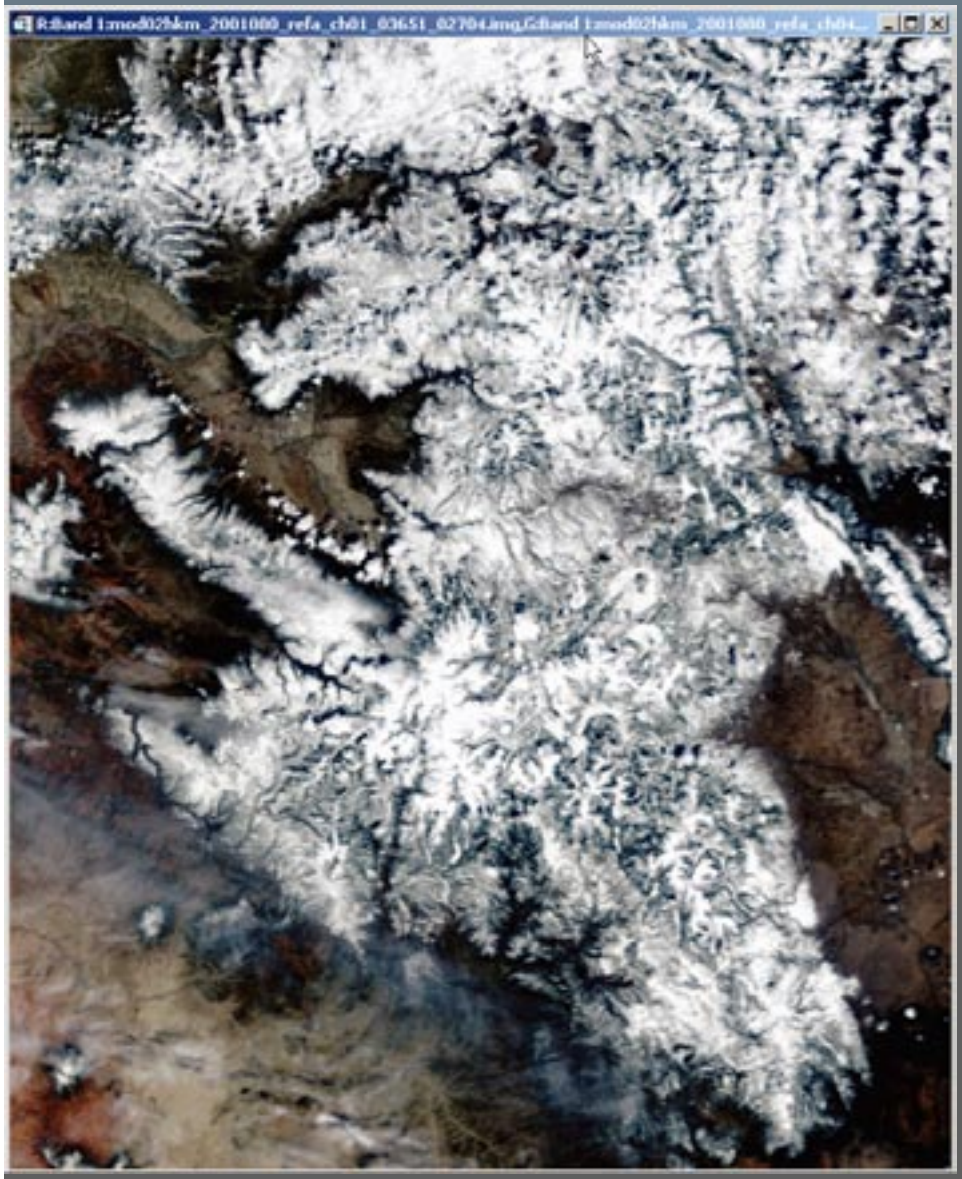
One granule of MODIS Level 1b Band 2 radiance data.

All 15 reflective bands selectable from a drop list.

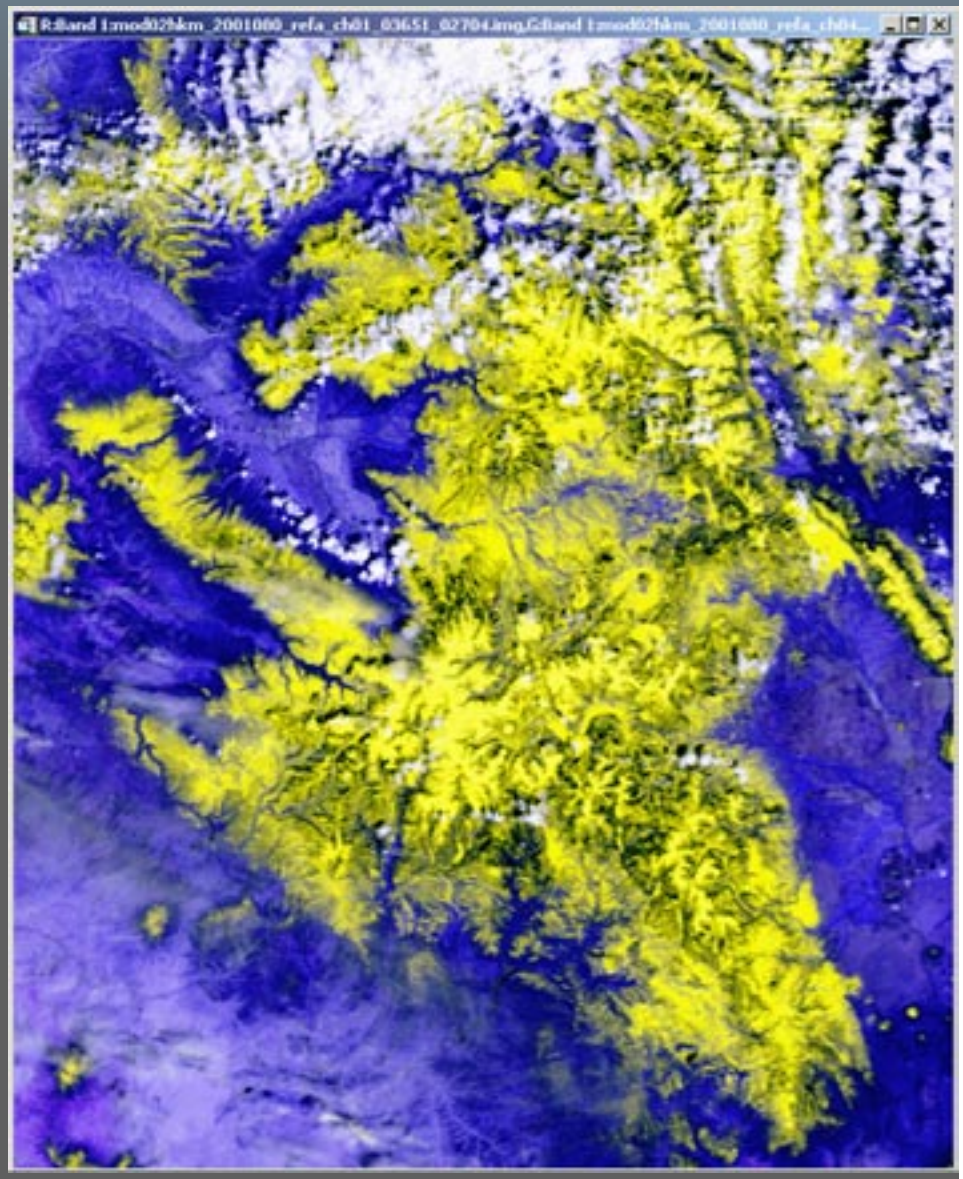
MODIS Bit Flag Viewer

- MODIS encodes important quality and other information as individual bits
  - Cloud mask information contained in 48 bits
  - Many land products have QA arrays where individual bits have separate meaning.
- Viewing these flags is not straightforward
  - NSIDC is developing add-on to PHDIS for this purpose

MODIS Bands 1,4,3 as RGB



MODIS Bands 1,4,6 as RGB



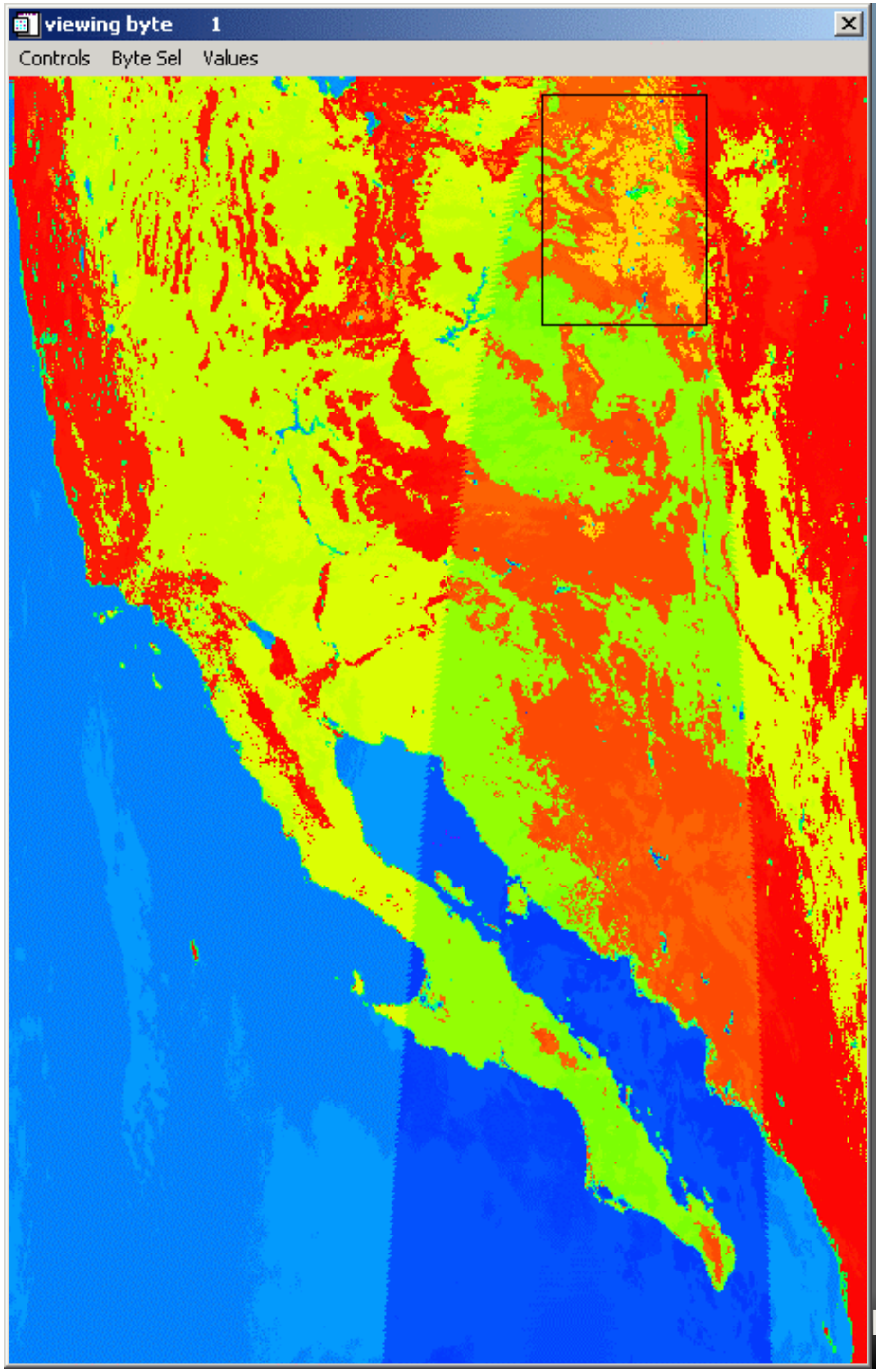


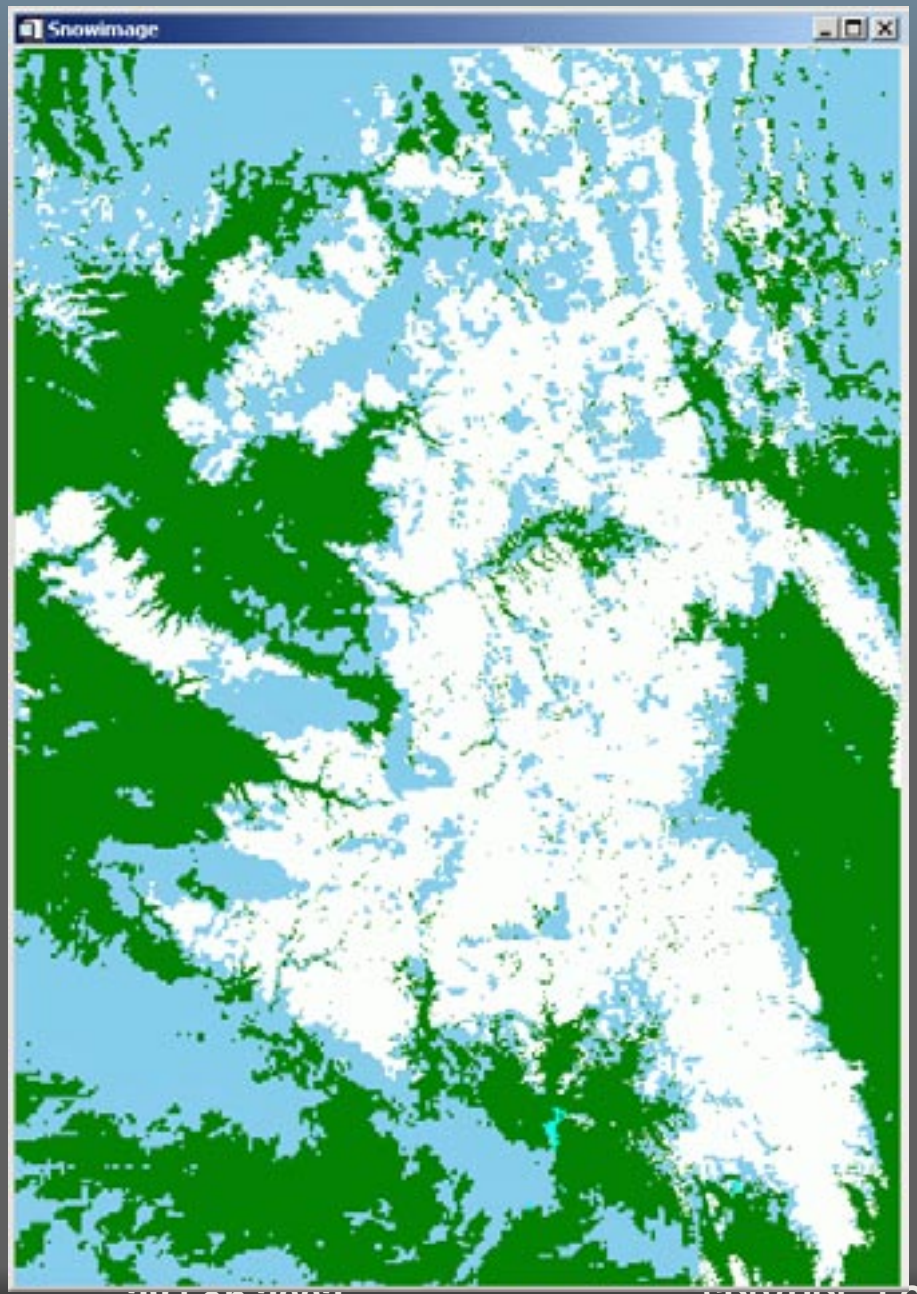
Image of byte 1 of MODIS Cloud Mask.

The 8 independent bits combine to yield a value between 0 and 255 which maps to a color.

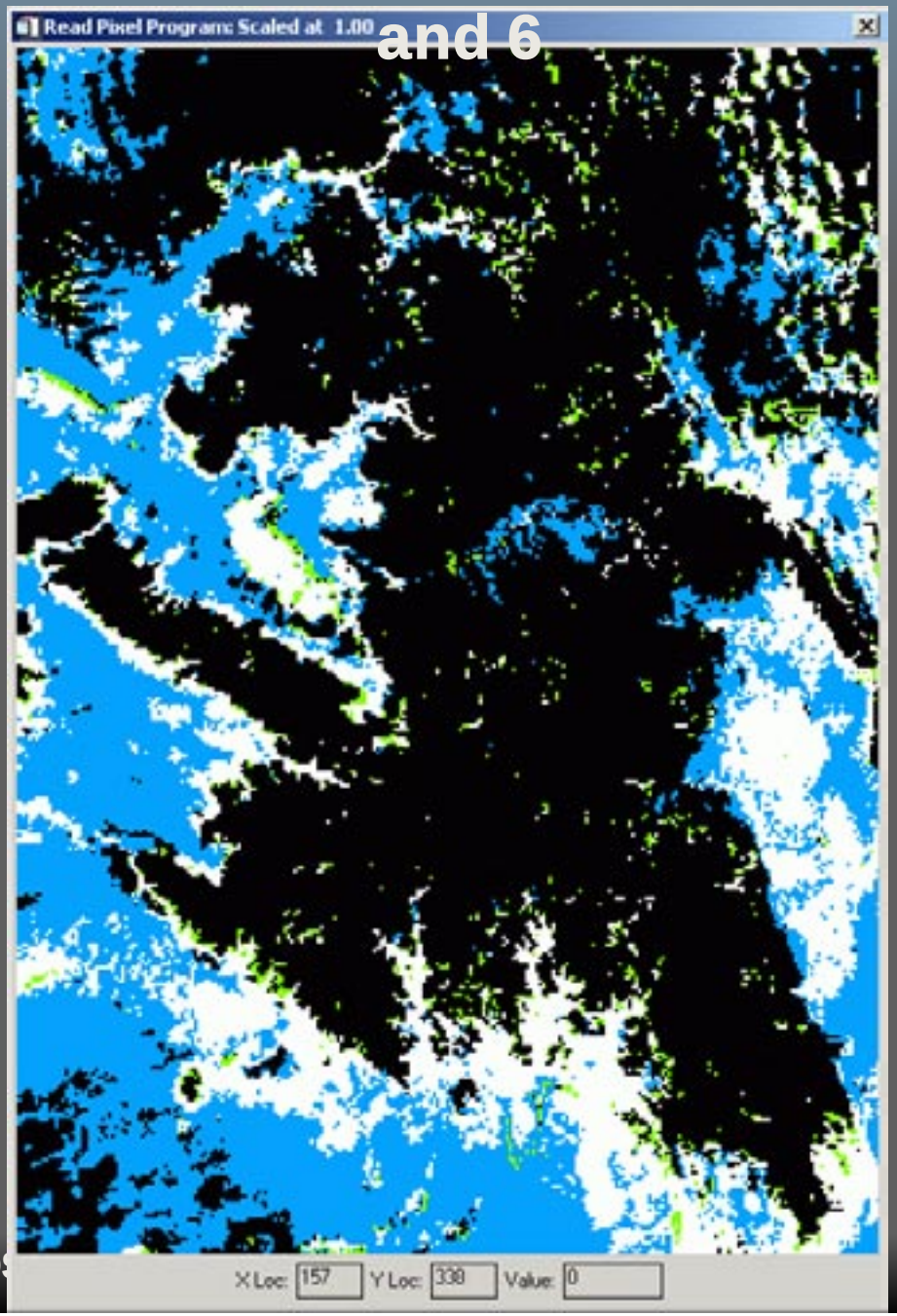
-But determining which bits are on and which are off based on color is nearly impossible.

-User selects a region for investigation

MODIS Snow Product



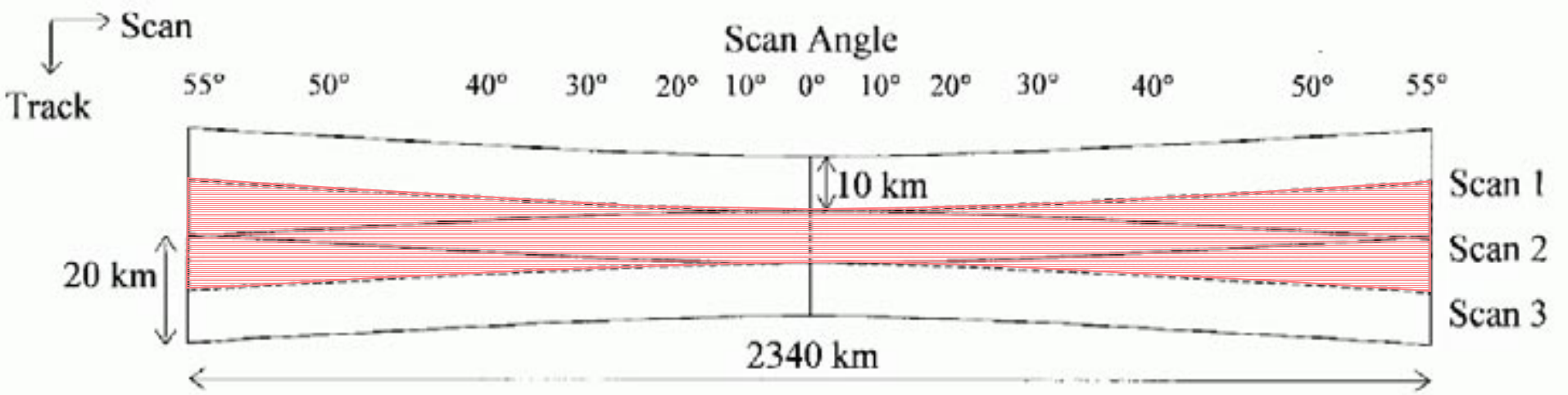
Cloud Mask Byte 3, Bits 5 and 6



MODIS Swath-to-Grid Toolbox

- Reads MODIS data in swath format and grids to selected projection
  - For radiance (L1b), snow or sea ice (L2) data
  - Can stitch together multiple swaths
  - Radiance can be converted to reflectance (vis) or brightness temperature (TIR)
- Can also read and grid ancillary data such as sensor or solar zenith angle
  - Can get geoloc/ancillary data from different file

MODIS Swath Geometry



Due to the “bowtie” effect, images made directly from swath data have a “double vision” appearance away from nadir.

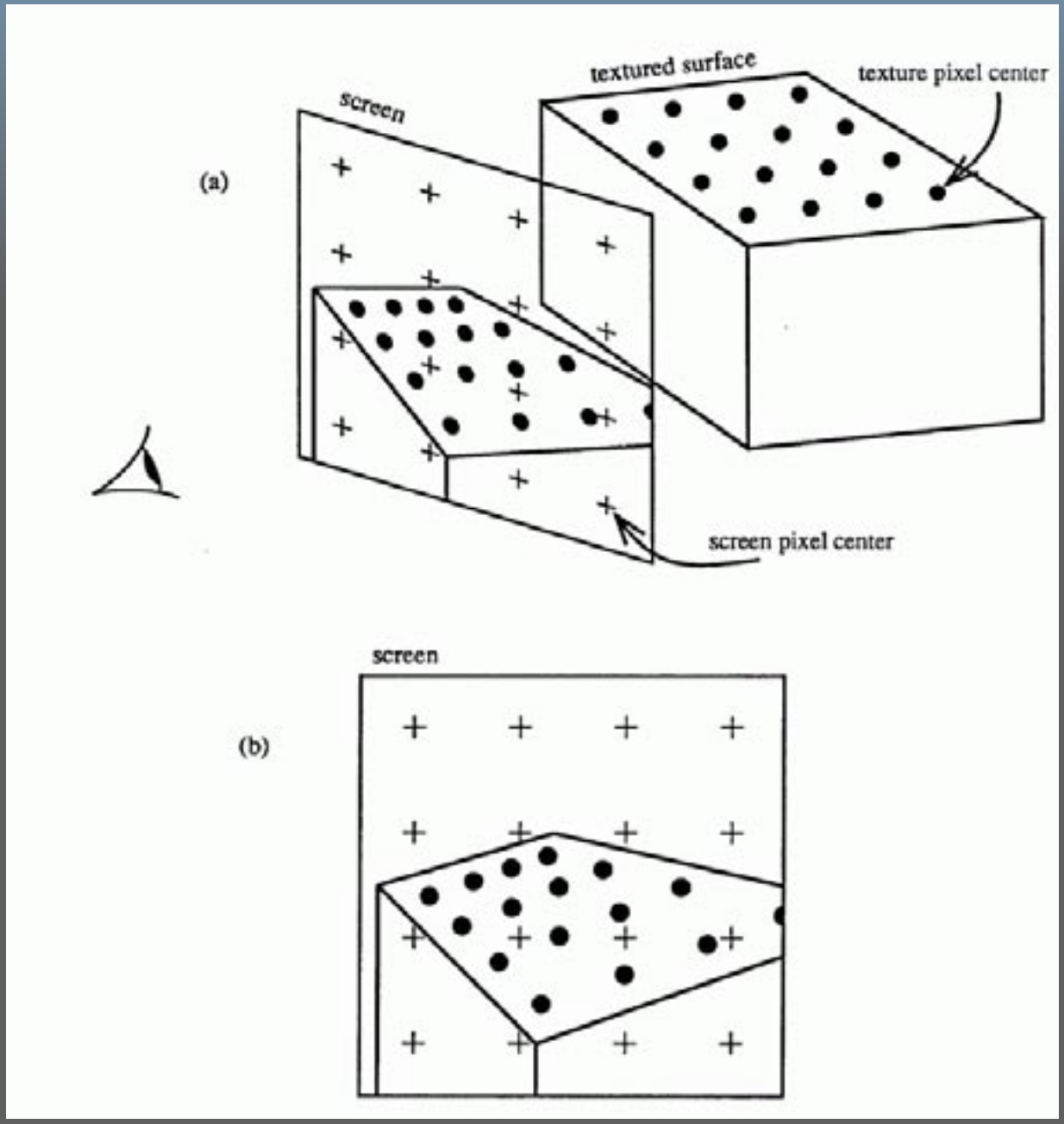
The same region after gridding.

Processing Sequence

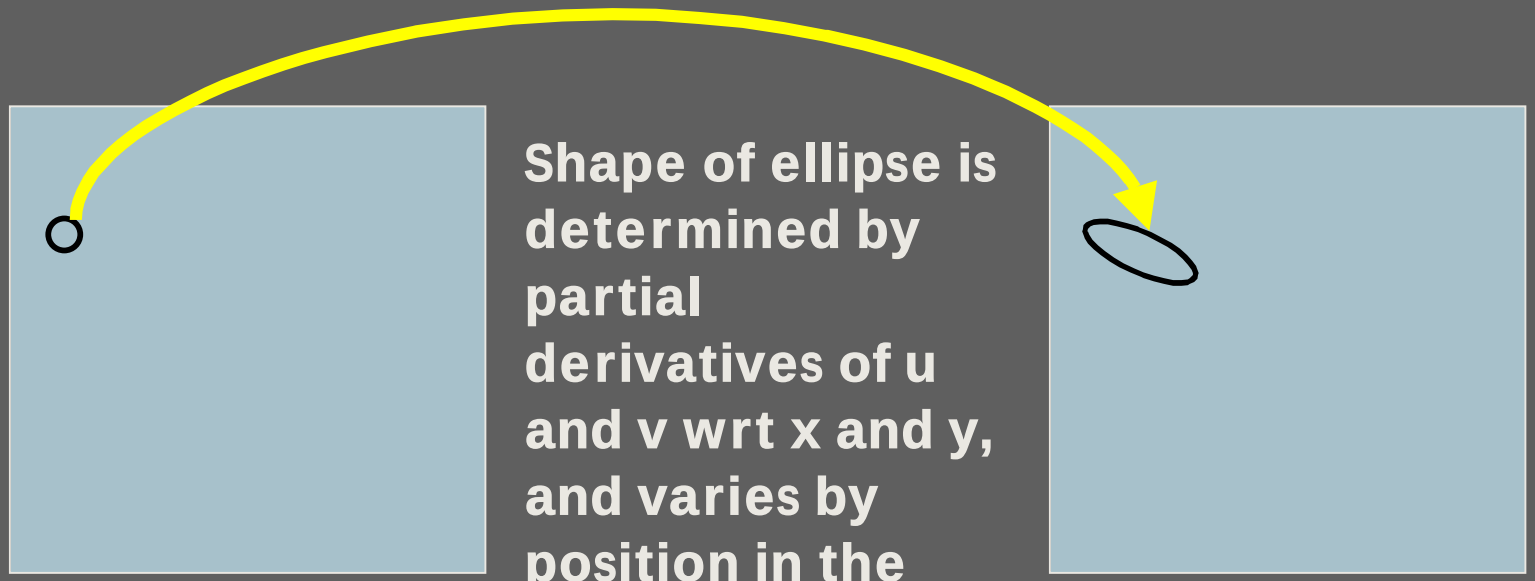
- Read science, lat/lon, and ancillary data arrays
- Convert lat/lon to row/col of target grid
- Interpolate row/col and ancillary arrays to resolution of science data arrays
- Map science and ancillary data arrays onto target grid using elliptical weighted averaging

Elliptical Weighted Averaging

- Space-variant filtering technique developed for texture mapping in image synthesis
- Well suited to mapping remote sensing data from instrument having wide range of viewing angles
- Computationally efficient


textured surface
texture pixel center
screen
(a)
screen pixel center
screen
(b)

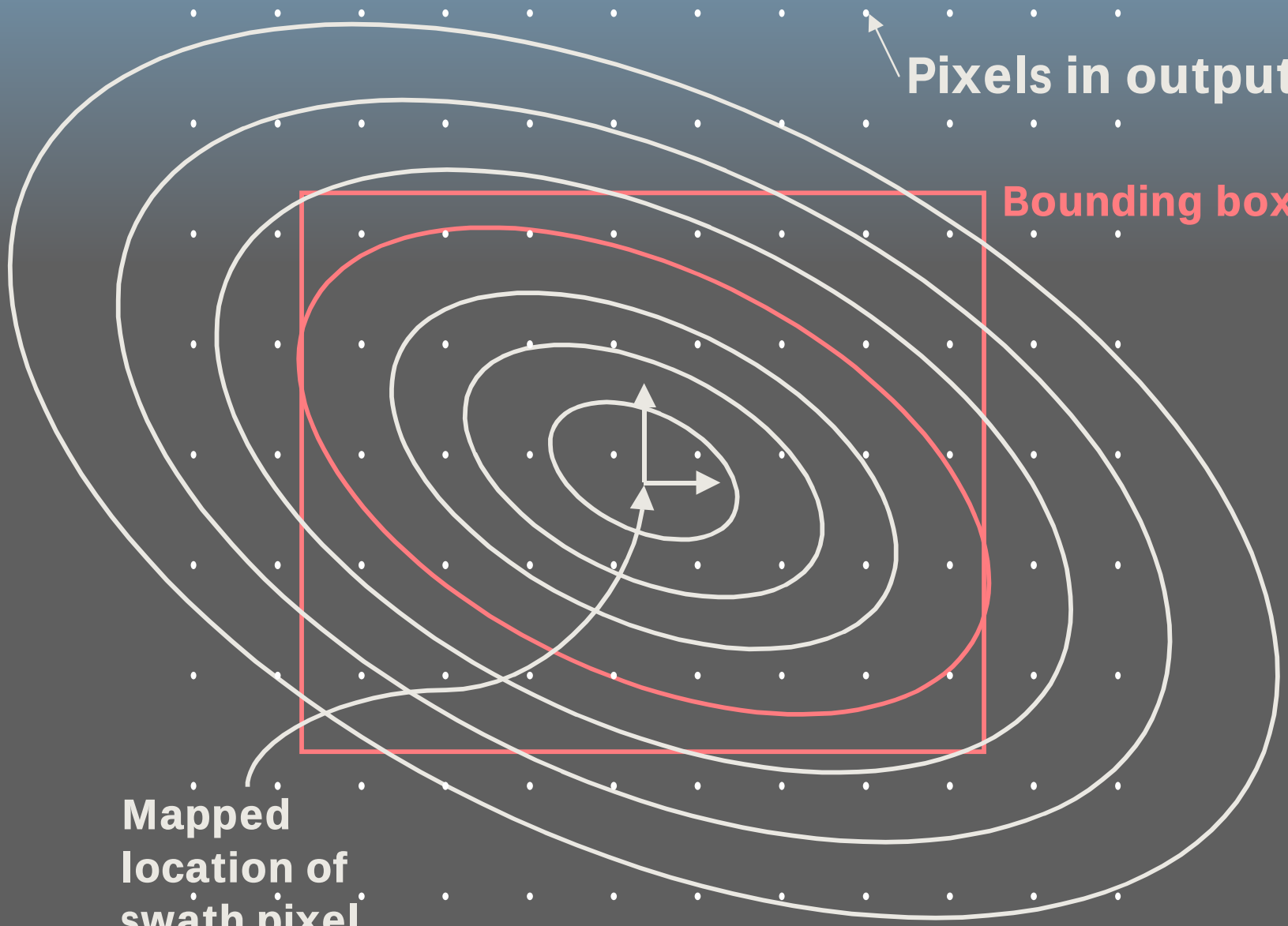
Basic Concepts



Shape of ellipse is determined by partial derivatives of u and v wrt x and y, and varies by position in the swath.

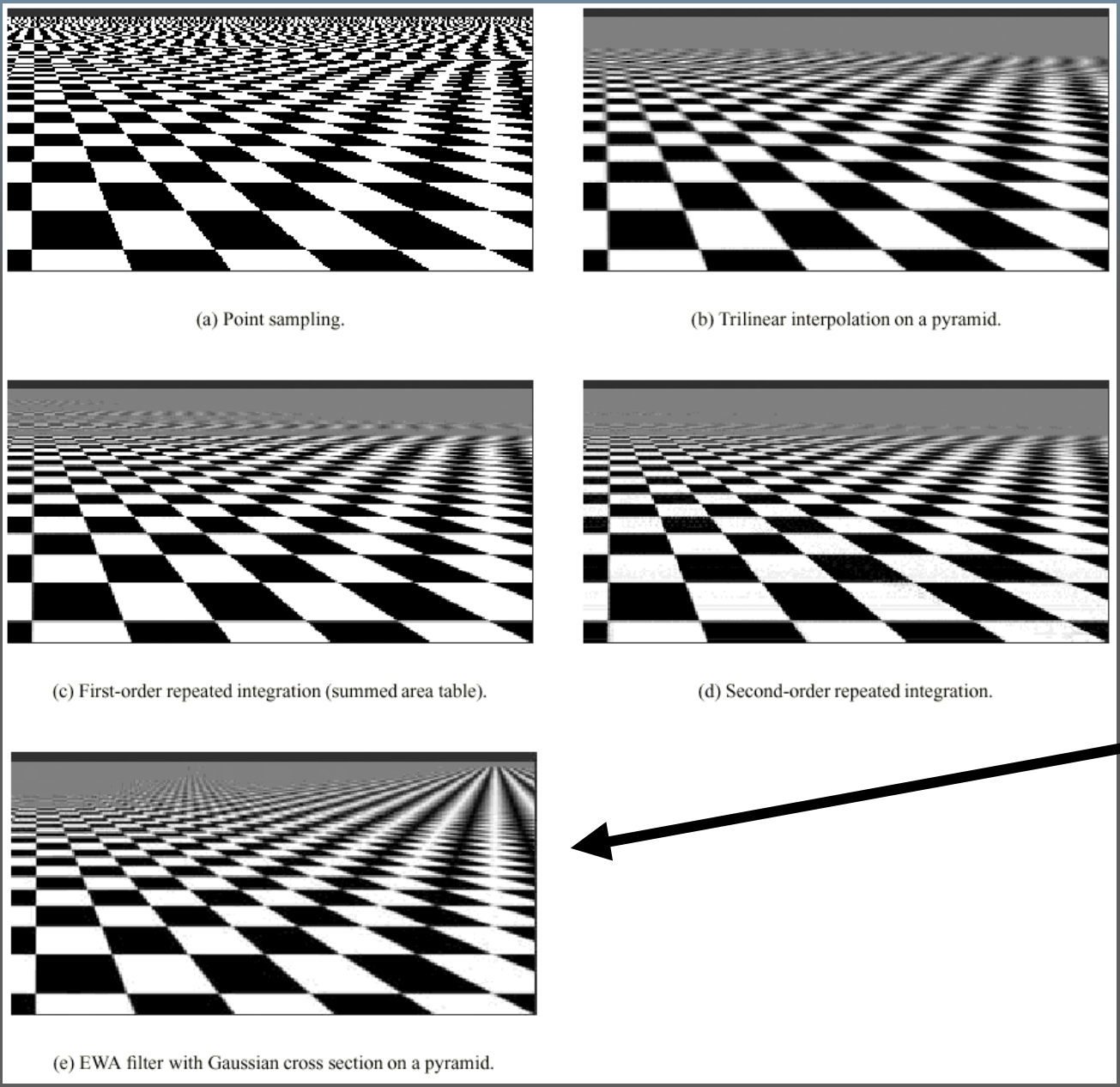
Swath space (x,y)

Grid space (u,v)


Pixels in output grid
Bounding box
Mapped location of swath pixel

EWA - options

- Can do elliptical weighted averaging *or* elliptical maximum weight sampling
- Gaussian weight table computed only once
- Tunable parameters
  - Max distance and weight at max distance
  - Minimum summed weight
  - Objective is to minimize smoothing without creating data voids in output grid



(a) Point sampling.

(b) Trilinear interpolation on a pyramid.

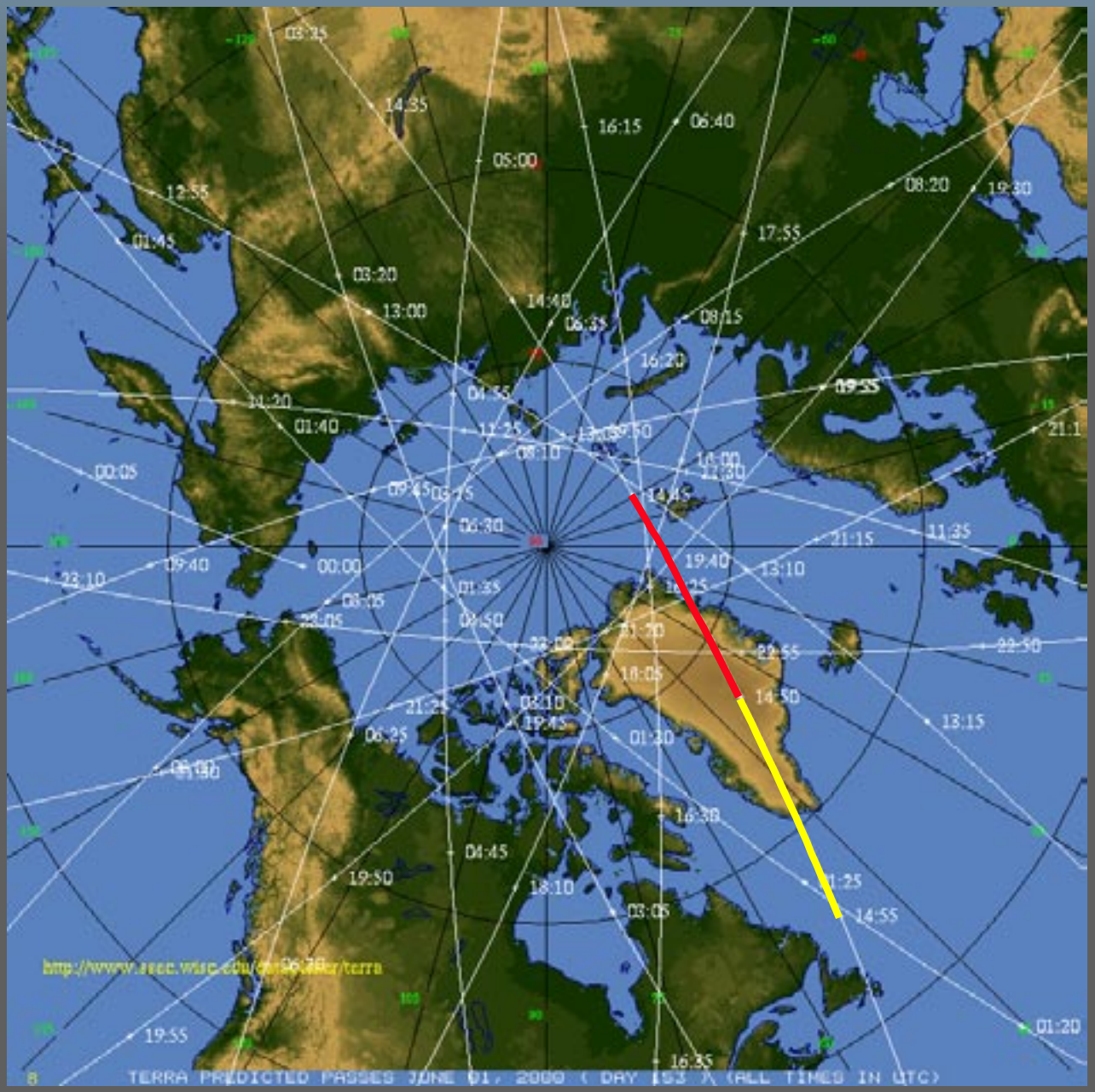
(c) First-order repeated integration (summed area table).

(d) Second-order repeated integration.

(e) EWA filter with Gaussian cross section on a pyramid.

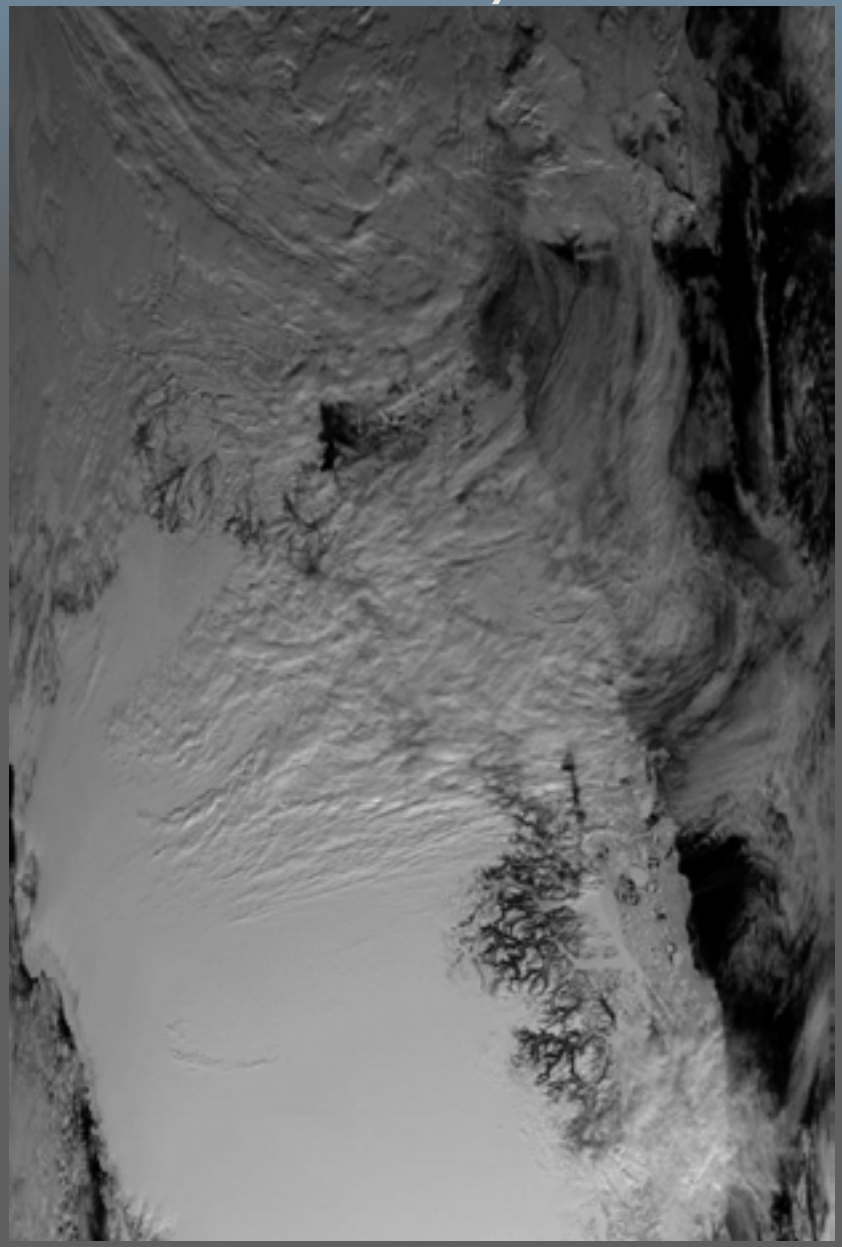
Comparisons of various texture mapping techniques.

EWA shows least distortion and greatest resolution.



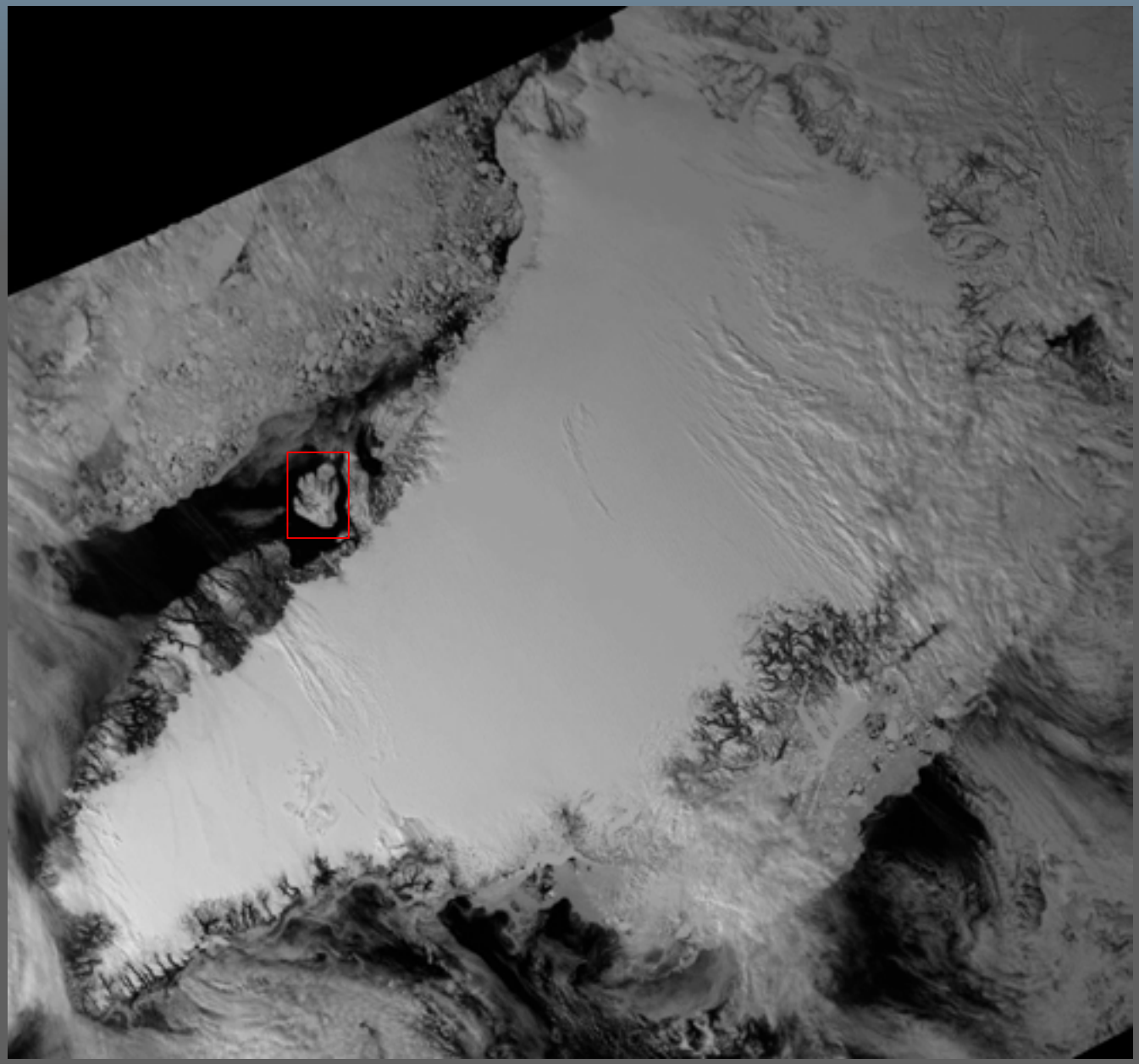
Orbit map used to select swath segments of interest.

1 June 2000, 1445Z



MODIS BAND 1

1 June 2000, 1450Z



Two MODIS swaths stitched together, subsetted, and gridded to EASE grid.

Summary of MS2GT

- Shows power and flexibility of HDF-EOS
  - Would require little or no modification to work with other MODIS Land products
  - Can extract all necessary information from a single file or can use ancillary data from other files
- Good candidate for running as external service
  - Can be scripted
- In use by a wide variety of MODIS product users

Future Directions

- PHDIS Tool
  - Enhanced swath support
  - Buy IDL run-time licenses so can distribute PHDIS as stand-alone tool to NSIDC users
- Bit Viewer
  - Arbitrary combinations of bits
  - Integrate into PHDIS Tool
- MS2GT
  - Replace IDL portions with C code
  - Reduce memory requirements
  - Add HDF-EOS and GIS output options

Website

- http://nsidc.org/PROJECTS/HDFEOS
  - Background
  - Presentations
  - Software (available for downloading)
  - Related links